Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

7g84mr
cop. 2

U.S. DEPT. OF AGRICULTURE
LIBRARY
MAY 15 1962
CURRENT SERIAL RECORDS

Shelling Equipment for Samples of Peanuts

Marketing Research Report No. 528

U.S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Market Quality Research Division
in cooperation with
North Carolina Agricultural Experiment Station

PREFACE

This study is part of a broad program of marketing research designed to maintain quality of farm products, improve marketing services, and hold down costs and increase efficiency in marketing farm products. This phase of the program is conducted to develop techniques, methods, and devices for the objective measurement of quality factors in agricultural commodities.

The Federal-State Inspection Services in Alabama, Georgia, North Carolina, Oklahoma, Texas, and Virginia assisted in the study. Personnel from the inspection services in these States helped set forth design requirements and carried out tests of the equipment described in this report. Personnel of the Fruit and Vegetable Division of the Agricultural Marketing Service cooperated in the development of the equipment.

Washington, D. C. March 1962

SHELLING EQUIPMENT FOR SAMPLES OF PEANUTS

by

James W. Dickens, agricultural engineer
Field Crops and Animal Products Branch
Market Quality Research Division
Agricultural Marketing Service [1]

SUMMARY

Equipment suitable for shelling samples of farmers' stock peanuts for inspection has been developed. The equipment shells a 500-gram sample in 3 minutes or less, and enables the use of samples larger than the 100-gram samples of Spanish- and Runner-type peanuts or the 8-ounce samples of Virginia-type peanuts which were used before the development of this equipment. The larger samples decrease greatly the sampling error in peanut grading.

The sample sheller gives an objective measurement of milling quality, an important quality factor for farmers' stock peanuts, and may meet the need for a standard method of determining milling quality by the entire peanut industry.

BACKGROUND

Samples of farmers' stock peanuts graded by the Federal-State Inspection Services are shelled to determine total weight of the kernels, distribution of size among the kernels, and the amount of rotten or discolored kernels in the sample. Another important factor, which affects the value of farmers' stock peanuts, called "milling quality", is a measure of the tendency of kernels to split in a mechanical shelling operation. Improper harvesting of peanuts with high-speed picking equipment can damage peanut kernels physically, and rapid drying will loosen the skins on the kernels so that they are more easily split. [2]

The traditional hand-shelling method for grading samples split few of the kernels and indicated very little about the milling quality of a load of peanuts. In addition, because hand shelling was costly and slow, it limited the size of the sample used to determine the quality of loads of farmers' stock peanuts. The standard 100-gram samples from loads of Spanish- and Runner-type peanuts and 8-ounce samples from loads of Virginia-type peanuts were generally considered inadequate. Moder and Penny (1954) [3] point out that a larger sample would significantly reduce the sampling error in grading.

In 1957, research was started by the United States Department of Agriculture in cooperation with North Carolina State College on the development of equipment to shell samples of peanuts for grading. The resulting development of a new method for shelling peanuts was reported by Dickens and Mason in 1959. [4] During 1959 and 1960, the new method was incorporated into the sample sheller which is described in this report.

---

[1] In cooperation with the Agricultural Engineering Department, North Carolina State College of Agriculture and Engineering, Raleigh, N. C.

[2] Beasley, E. O., and Dickens, J. W. Annual Progress Report on Peanut Curing Studies. 1960. [Unpublished N. C. Agr. Exp. Sta. Rpt.]

[3] Moder, J. J., and Penny, N. M. Industrial Engineering and Economic Studies of Peanut Marketing. 1954. Eng. Exp. Sta. Ga. Inst. of Technol. and Ga. Exp. Sta., Bul. No. 286.

[4] Dickens, J. W., and Mason, D. D. A Peanut Sheller for Grading Samples: An Application of Statistics in Design. 1959. [Paper No. 59-317 presented to 1959 Annual Meeting American Society of Agricultural Engineers, Ithaca, N. Y. Unpublished.]

DESCRIPTION OF THE SAMPLE SHELLER

The principles of operation of the sheller are illustrated in figure 1. When poured into the shelling hopper, the peanuts flow through the sheller bars and rest on the grid, which has perforations just large enough to pass the shelled kernels. The grid is reciprocated and the resulting forces on the peanuts between the moving grid and the stationary sheller bars break open the pods. Most of the shelling is accomplished by the random wedging action among the peanuts between the grid and the sheller bars. During shelling, agitation caused by the reciprocating grid causes the kernels to move down through the perforations in the grid before being subjected to excessive shelling action. The springs on the sheller-bar frame allow the sheller bars to be forced upward by peanuts when the hopper is full, but cause the bars to move downward as the peanuts are shelled so that all of the peanuts in the hopper are shelled.

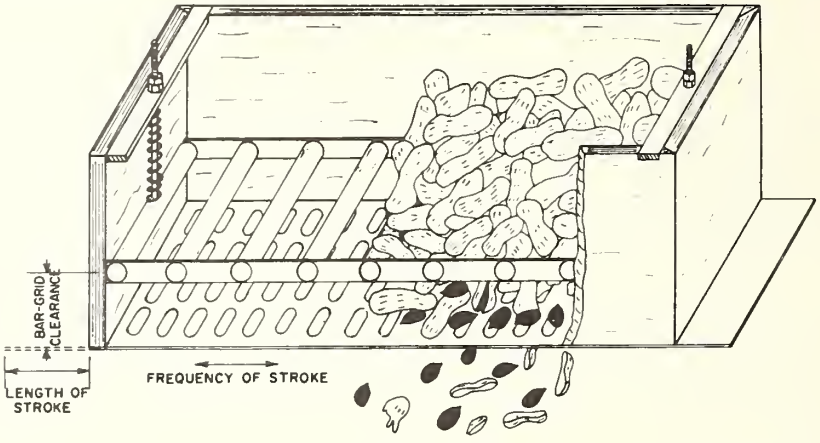


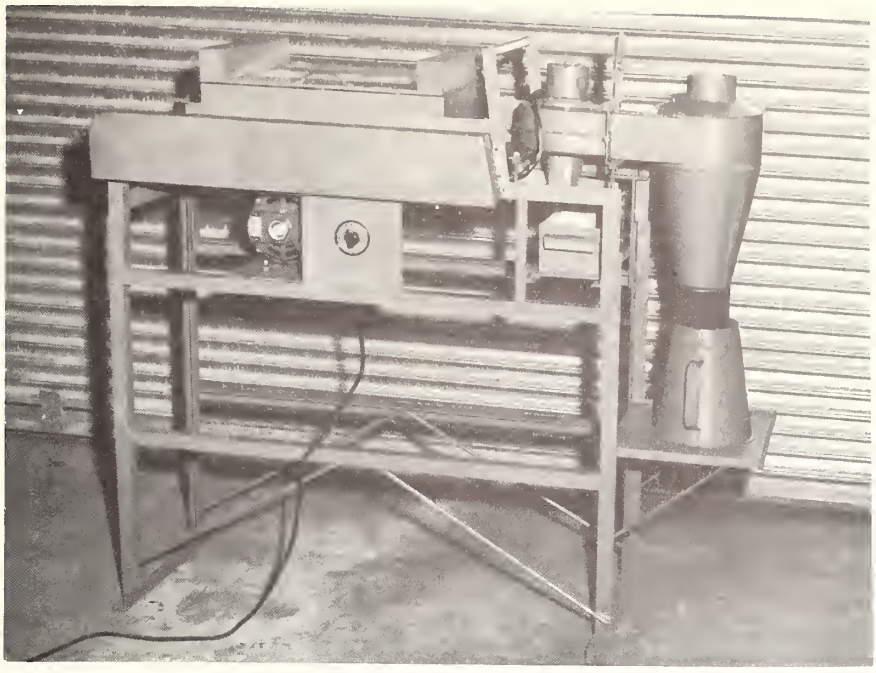
Figure 1.--Diagram of the operating principles of the sample sheller.

Tests reported by Dickens and Mason (1959)[5] indicate the optimum frequency of stroke, bar-grid clearance, and length of stroke to be 175 strokes per minute, 1 inch, and 2 1/2 inches, respectively. The springs which hold down the sheller bars are selected so that approximately 1-inch bar-grid clearance is maintained by the upward pressure of the peanuts as long as sufficient peanuts are in the hopper, but the bar-grid clearance is reduced toward the end of the shelling operation as all of the peanuts are shelled. Stops maintain sufficient bar-grid clearance to prevent wedging shelled kernels between the sheller bars and the reciprocating grid.

Figure 2 is an overall view of the sheller. The peanuts are placed in the hopper and are shelled. The hulls and kernels then fall into a sloped trough which is fastened to a shuttle frame beneath the reciprocating shelling grids. The reciprocating motion of the trough causes the material to pass beneath the fan intake where the hulls are lifted and deposited in the catch pan beneath the cyclone cleaner. The kernels fall into a catch pan at the end of the trough. A damper on the discharge of the fan can be used to adjust the suction of the fan for proper cleaning. The timer shown on the sheller can be preset for a given length of shelling time. The 1/3-hp. motor which reciprocates the shuttle frame can also be seen in the picture.

Size of the peanuts in a sample varies widely so that some of the kernels are as large as the smaller pods. A shelling grid that has perforations large enough to pass the larger kernels will pass the small peanuts before they are shelled. So that all pods can be shelled, the sheller hopper is divided into three compartments. Each compartment has a different shelling grid under it for shelling a certain size-range of peanuts. The peanuts

[5] See footnote 4, p. 3.



BN-15154-X

Figure 2. --Overall view of the sample sheller.

are sized into three classes in a manner to be discussed in the next section of the report. The different size classes are then dumped into the proper compartment of the sheller.

A top view of the sample sheller is shown in figure 3. The three compartments can be seen with the threaded lift rods and jam nuts which are used to adjust the bar-grid clearance. A clear plastic top enables the operator to see when shelling is completed. The holes in the end blocks of the lid allow the lift rod and jam nuts to move upward as peanuts force the sheller bars up and compress the springs shown in the picture.

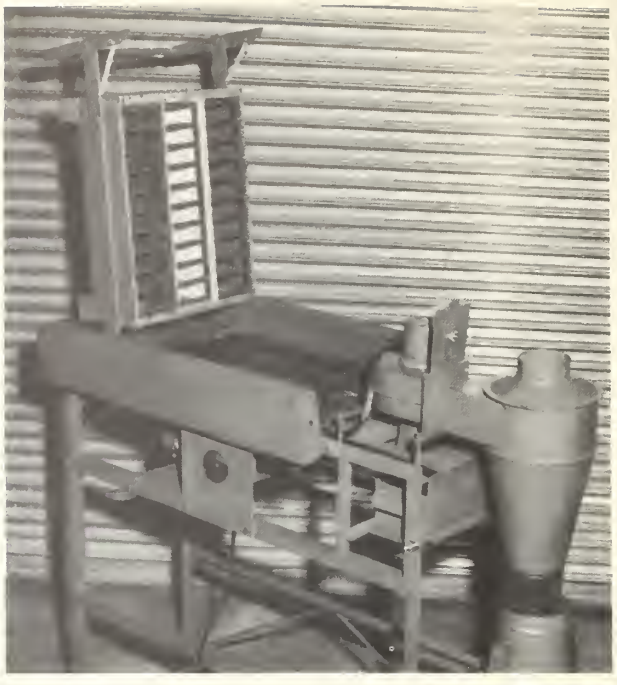
A satisfactory sample sheller must be easy to clean between samples. Figure 4 shows the sheller hopper raised so that any material left on the sheller grids can be easily removed. The three independent sheller-bar assemblies can be seen as well as the three different shelling grids which are fastened to the grid frame. The blank ends of the grids slide beneath the ends of the hopper so that no peanuts are crushed between the grid perforations and the ends of the hopper box.

Different varieties of peanuts require different grid openings for proper shelling. The sheller can be easily changed for different varieties by changing the grid frame as shown in figure 5. Two tapered pins welded to the grid frame fit into holes bored in the shuttle frame.

An eccentric drive is used to reciprocate the shelling grids. Connecting rods extend down each side of the machine, beneath the fenders, to a cross bar that is attached to the shuttle frame.

BN-15158-X

Figure 3. --Top view of the sample sheller.



BN-15157-X

Figure 4. --Sheller with the hopper raised.

BN-15153-X

Figure 5. --Shelling grids are easy to change for different varieties.

DESCRIPTION OF THE PEANUT SIZER

The samples of the peanuts must be sorted according to pod size before shelling. Peanuts are fed by the sizing machine into a trough formed by two precisely spaced parallel steel rollers which are rotated as shown in figure 6. The rollers are rotated at 120 r.p.m. and are sloped downward at a 23-degree angle so that the force of gravity and the rotation of the rollers cause the peanuts to slide along between them.

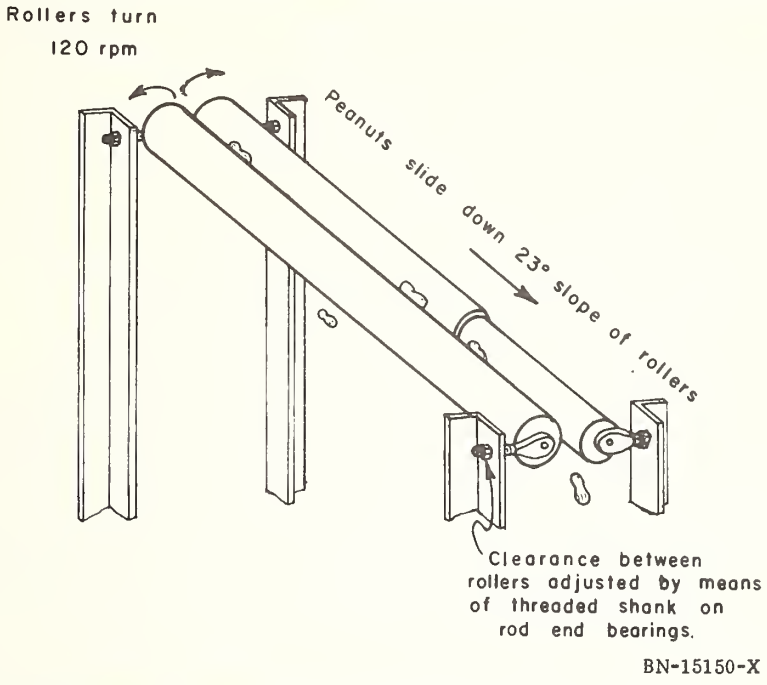

Rollers turn
120 rpm
Peanuts slide down 23° slope of rollers
Clearance between rollers adjusted by means of threaded shank on rod end bearings.
BN-15150-X

Figure 6.--Diagram of the operating principles of the peanut sizer.

Tests were conducted to determine sizing-roller spacings and corresponding sheller-grid openings that would give a minimum quantity of unshelled peanuts and split kernels when the peanuts were shelled. Both roller spacing and grid opening were varied in tests on all three major varieties of peanuts (table 1).

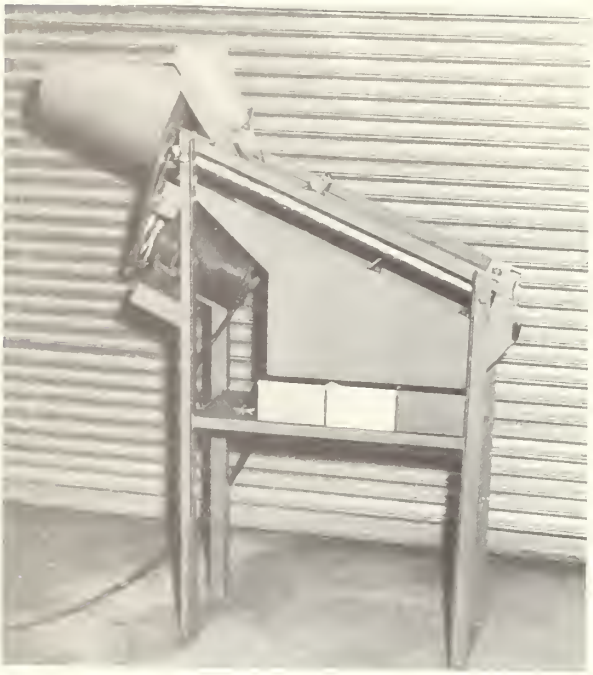
TABLE 1.--Peanut-sizer roller spacings and corresponding sheller-grid openings

Peanut type	Roller spacing	Grid opening
Runner	under 25/64 inch	18-1/2/64 x 1-1/4 inches
	25/64 inch to 29/64 inch	20-1/2/64 x 1-1/4 inches
	over 29/64 inch	24/64 x 3/4 inches
Spanish	under 25/64 inch	18-1/2/64 x 1-1/4 inches
	25/64 inch to 29/64 inch	20-1/2/64 x 1-1/4 inches
	over 29/64 inch	22-1/2/64 x 1-1/4 inches
Virginia	under 34/64 inch	24/64 x 3/4 inches
	34/64 inch to 38/64 inch	30/64 x 3/4 inches
	over 38/64 inch	34/64 x 1-inch

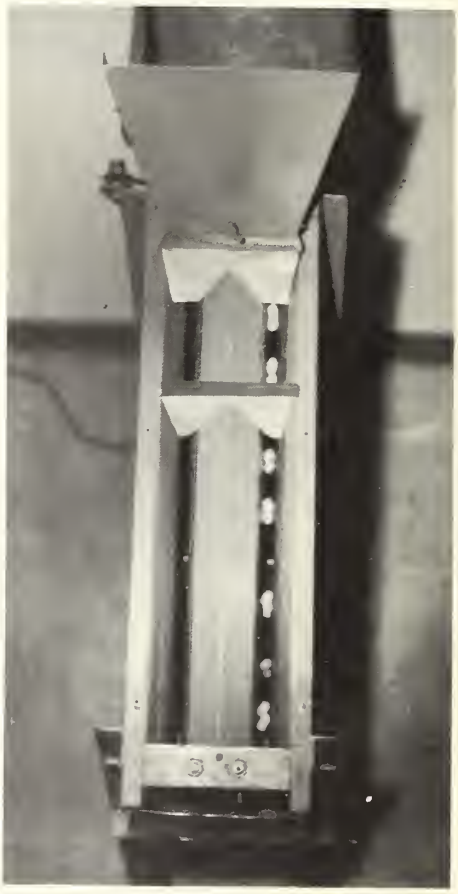
On the sizing machine a stepped roller is mounted parallel to a smooth roller. The step in the roller is 4/64 inch, so that when the distance between the rollers at one end is 25/64 inch, the spacing at the other end is 29/64 inch (for Spanish- and Runner-type peanuts) or when the spacing is 34/64 inch at one end, the spacing is 38/64 inch at the other end (for Virginia-type peanuts). The small peanuts fall through the narrow spacing, the medium peanuts fall through the wide spacing, and the large peanuts ride over the end of the rollers.

An overall view of the sizing machine shows the drive motor for the rollers and the feed hopper (figure 7). The chute and catch pans for the three sizes of peanuts are also shown.

Figure 8 shows the four rollers necessary for sizing Spanish-, Runner-, and Virginia-type peanuts. If only Virginia-type peanuts or only Spanish- and Runner-type peanuts are to be sized, only two rollers are necessary. The peanuts can easily be directed over the rollers for either the Virginia- or the Spanish- and Runner-type peanuts by means of a diverter mounted in the chute from the feed hopper. Spacing between the rollers can be adjusted by means of threaded shanks and jam nuts on the rod-end bearings which support the rollers.



BN-15159-X
Figure 7.--Overall view of the sizing machine.



BN-15155-X
Figure 8.--Top view of the sizing machine.

The finger wheel in the feed hopper is designed so that it will feed all major types of peanuts properly (figure 9).

Since the sizing machine will effectively size a 500-gram sample in approximately 2 minutes, it will size peanuts as rapidly as the sheller will shell them. The sizer is self-cleaning. No peanuts hang between the rollers as they do in the openings in perforated metal when peanuts are hand-screened.

Tests of the sizing machine have shown that it is also satisfactory to indicate the percentage of Fancy-size pods in farmers' stock peanuts. The previous method of hand-screening the peanuts over 34/64-inch by 3-inch slots was difficult and slow. Use of the sizer has made it feasible to double the size of sample, from 8 ounces to 1 pound, used to determine the percent of Fancy-size pods.

BN-15156-X

Figure 9. --The finger wheel in the feed hopper of the sizing machine.

SHELLING TESTS

The percentage of split kernels in grading samples is important to the farmer because the halves will pass through the official grading screen, reduce the percentage of kernels riding the screen, and thus lower the grade of the sample.

To determine the amount of splits which would be caused by machine-shelling of samples for grading, tests were designed by the Fruit and Vegetable Division of the Agricultural Marketing Service and were carried out by the Federal-State Inspection Service in the various States. To test the three major types of peanuts and the many different

conditions of these peanuts when graded, samples were selected throughout each of the major peanut-growing areas during the marketing season. The samples were drawn from randomly selected loads of farmers' stock peanuts during the grading operation.

Table 2 shows the effects of machine-shelling versus hand-shelling on the average percentages of splits in the shelled samples of the three types of peanuts tested. Duplicate samples of peanuts were shelled by hand and by machine. For hand-shelling, 100-gram samples of Spanish and Runner types of peanuts and 200-gram samples of Virginia-type peanuts were used. All machine-shelled samples weighed 500 grams.

Table 3 shows the general distribution of the machine-shelled samples in relation to the percentage of splits. Moisture content at the time of shelling, curing treatment, and harvesting treatment affect the amount of splits caused by machine shelling. The higher

TABLE 2.--Percent split kernels in machine- and hand-shelled samples of peanuts

Type of peanuts	Number of comparisons	Average percentage of split kernels		
		Machine-shelled	Hand-shelled	Difference
Spanish	655	3.0	.4	2.6
Runner	482	1.8	.3	1.5
Virginia	368	1.7	1.0	.7

TABLE 3.--Distribution of peanut samples as related to the percentage of splits caused by machine shelling

Percent of sound splits	Type of peanut		
	Spanish (655 samples)	Runner (482 samples)	Virginia (368 samples)
	Percent	Percent	Percent
0-1	18.3	36.4	87.6
1-2	25.5	39.2	11.3
2-3	23.5	16.6	1.1
3-4	11.2	5.8	0
4-5	10.8	1.0	0
5-6	4.7	.8	0
6-7	3.8	.2	0
over 7	2.2	0	0

percentage of splits probably was caused either by low moisture content at time of shelling, rapid drying during the curing operation, rough harvesting treatment, or by a combination of these factors.

Figure 10 shows the relationships between kernel moisture content of the samples and the amount of splits caused by machine shelling for three types of peanuts. The harvesting and curing treatments of the samples have a great deal to do with the amount of splits caused in a given sample at a given moisture level but, in general, the amount of splits would be expected to vary with moisture content as shown. Further tests on a large number of carefully controlled samples would permit a more precise definition of the relationships between splitting and moisture content for various curing treatments.

The fact that curing treatment affects the amount of splits caused by the sample sheller has been demonstrated by Beasley and Dickens (1960).[6] When shelled, at the same moisture content, on the sample sheller, Virginia-type peanuts which were dried slowly at 90° F and 81-percent relative humidity, had an average of 1.47-percent splits, whereas peanuts dried more rapidly at 115° F and 46-percent relative humidity had an average of 6.62 percent of splits.

Dickens (1960)[7] and others reported that high-temperature curing produces off-flavor in peanuts. At the present time, there is no objective method for detecting the presence of off-flavor in samples. Because the rate of drying increases with high-temperature curing in most curing systems, excessive splitting would occur in most of the samples containing off-flavor produced by high-temperature curing.

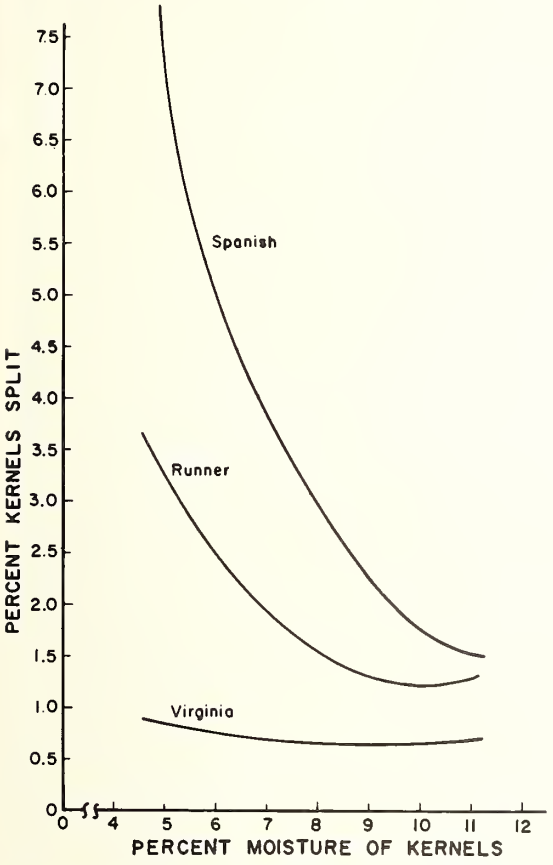


Figure 10.--Relationships between moisture content and kernels split by machine shelling.

Harvesting treatment also affects the amount of splits. In shelling tests on samples of peanuts harvested by various methods, Virginia-type peanuts with 2-percent shelled kernels in the sample after harvesting had less than 0.7-percent splits when shelled, with the sample sheller. Peanuts with 20-percent shelled kernels in the sample after harvesting, had over 3.6-percent splits. Loose shelled kernels indicate the physical damage peanuts receive in harvesting and subsequent handling prior to shelling.

A STANDARD MEASUREMENT OF MILLING QUALITY

Because of the development of new varieties, change in cultural practices, and increased use of rapid-harvesting equipment and bulk curing for peanuts, the shelling industry has become concerned about the amount of splits caused by commercial shelling. The shelling industry, therefore, wishes to place more emphasis on the milling quality of the peanuts purchased. (Pace, 1961).[8]

The sample sheller is a tool for the determination of milling quality. It can be used to evaluate the milling quality of small samples of peanuts from tests in breeding, fertilization, harvesting, curing, and other types of research on cultural practices for peanuts. At present, several tons of peanuts are required for shelling tests in large shelling plants, so it has seldom been feasible to consider milling quality when recommendations based on research results are given to the grower. The shelling industry might also use the results of tests with the sample sheller as a standard for the adjustment of existing shelling equipment and the development of new equipment. If the industry as a whole were to use the sample sheller as a standard means of measuring milling quality, it could be an important tool in coordinating the efforts of the producer and the processor to produce high-quality peanuts and peanut products.

---

[6] See footnote 2, p. 3.

[7] Dickens, J. W. Curing Methods and Techniques as Influencing Quality. 1960. [A part of the minutes of the Membership Meeting of the Peanut Improvement Working Group, Columbus, Ga.]

[8] Pace, Stephen. National Peanut Research Center. 1961. [Paper presented to the 21st Ann. Conv., Natl. Peanut Council, Washington, D. C. Unpublished.]

☆ U. S. GOVERNMENT PRINTING OFFICE : 1962 O - 631632

Growth Through Agricultural Progress